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COLUMBIA SQUARE
555 THIRTEENTH STREET, NW
WASHINGTON, DC 20004-1109
TEL (202) 637-5600
FAX (202) 637-5910

July 18, 2000

Magalie Roman Salas
Secretary
Federal Communications Commission
445 Twelfth St., S.W.
Washington, D.C. 20554

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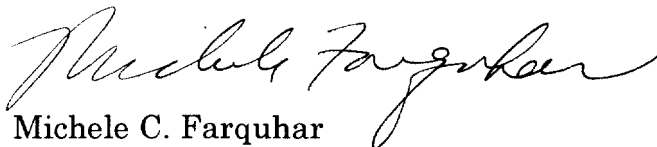
Re: FCC Notice of Inquiry Regarding Software Defined
Radios; ET Docket No. 00-47,

Dear Ms. Salas:

I am writing to inform you that Dick Blake, consultant for AirNet Communications Corporation ("AirNet"), and I (counsel to AirNet) made a short *ex parte* presentation on Friday, July 14, 2000 to the FCC's Office of Engineering and Technology ("OET") in the above-referenced proceeding. FCC staff present were: Dale Hatfield, OET Chief; Julius Knapp, Chief, OET Policy and Rules Division; and Hugh Van Tuyl, OET Senior Engineer.

During this meeting, AirNet addressed several issues raised in its Reply Comments, attached. Please contact me if you have any questions.

Respectfully submitted,



Michele C. Farquhar
Counsel for
AirNet Communications Corporation

Enclosure

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BEFORE THE
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In the Matter of

Inquiry Regarding Software Defined Radios

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ET Docket No. 00-47

FEDERAL COMMUNICATIONS COMMISSION
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**AirNet Reply Comments
Filed to the
FCC Notice of Inquiry

ET Docket No. 00-47**

July 14, 2000

Introduction

AirNet[®] Communications Corporation is pleased to provide these reply comments in response to the FCC Notice of Inquiry related to Software Defined Radios (SDR) and identified as ET Docket No. 00-47.

Background

AirNet is a United States based manufacturer of telecommunications equipment. AirNet's product portfolio is based on the principles of a Software Defined Radio network architecture serving the wireless industry. This technology was originally conceived at Harris Corporation and developed at AirNet into a commercial technology. *AirNet is the only manufacturer in the world actively developing and commercially deploying SDR base stations using Digital Signal Processing (DSP) techniques to control power, frequency, modulation, and signaling protocols, and to provide multiple protocols (multi-mode) multiple frequency band (multi-band) wireless services. In 1998, AirNet's SDR technology became the only infrastructure ever to be awarded the prestigious "Best Technical Innovation Award" by over 200 worldwide service providers.* AirNet has numerous SDR related patents granted, allowed, and pending.

Reply Comments

Top AirNet Messages

- Software Defined Radio technology is economically available and in commercial deployment today.
- SDR technology benefits U.S. and international consumers, wireless operators, and wireless infrastructure manufacturers.
- SDRs can improve interoperability.
- SDRs do not warrant regulation changes or re-certification for software upgrades.

AirNet reply comments are organized in four subject areas:

1. State of Software Defined Radio Technology
2. Interoperability
3. Improved Spectrum Efficiency and Spectrum Sharing
4. Equipment Approval and Regulation Changes

1. State of Software Defined Radio Technology

AirNet has reviewed all comments submitted to the FCC in accordance with ET Docket No. 00-47 and is submitting a limited number of reply comments. As a summary, there appears to be two very distinct and opposing views relative to the state of the art. Fortunately, there are only a few that feel that SDR is not viable within the next ten years but the vast majority of the responses including most members of the SDR Forum agree with AirNet that there is sufficient technology to develop and implement SDR today.

AirNet has reviewed the SDR Forum (SDRF) comments in regards to the State of the Software Defined Radio Technology and agrees with the features and functions that can be controlled by today's technology and those in the near and longer term evolution. In addition, the SDRF is accurate in their assessment of the cost savings of reduced platform-development costs, reduced component costs, and in the reduced operating and maintenance costs. Many of those savings can be found today. In regards to cost effectiveness, AirNet disagrees with Nortel's comments in terms of large dynamic range, high linearity, and wide bandwidth SDR receiver at reasonable cost. AirNet has proven through competitive pricing with its commercial base station products that such a device can be manufactured at a comparable cost to narrow band equipment today under similar volume.

BellSouth states that the economics of a cost-based SDR business model is of utmost importance for their deployment. BellSouth further states that the different commercial, government, and military markets will deploy SDR at different paces as a function of their priorities and individual economic requirements. Evidence of this is readily seen in

the military deployment plans. Public safety organizations are addressing the issues due to their lack of interoperability. Many comments to the NOI have stated that technology is the impediment to the deployment of SDR, AirNet supports BellSouth in their belief that economics and need will be the primary driving forces that will dictate the implementation of SDR and not technology.

The National Telecommunications Industry Association (NTIA) states in their comments that the use of SDR technology may be limited by size, weight, power, performance, and the current state of the SDR technology is not mature. The NTIA stated that when SDR can replace several hardware-based single-function radios, these disadvantages may be acceptable. AirNet believes that although this may be true with some manufacturers that maintain that "SDR is an exciting future vision to be viewed as a long term goal," AirNet can demonstrate that today's state of the art is sufficient to deploy a cost-competitive SDR and provide multi-mode/multi-band capabilities to dynamically control frequency, modulation, power and protocol on a per-channel basis. AirNet's AdaptaCell™ Broadband Software-Defined Base Transceiver Station and the AirSite® Backhaul Free Base Station™ are competitively priced and are presently deployed within 14 States and serving over 20 systems. In addition, the overall dimensions, including the footprint, and power consumption are less than those of a single-technology base station.

Motorola states that "SDR will allow significant flexibility in hardware platforms, which will benefit the consumer, the network operator, and the equipment manufacturer. SDR technology will also advance multi-mode, multi-band, and multifunction efficacy, while empowering a broader range of robust applications at the user interface." AirNet agrees with Motorola but also emphasizes that this can be made available using today's technology rather than the future. AirNet broadband transceivers accommodate the PCS spectrum and DSPs are used to provide the computing power for software defined radio. Equipment manufacturers will converge on common hardware platform so that they can support many different air interfaces and thus reduce manufacturing costs. From a manufacturer's perspective, SDR could unify the various radio designs into one platform design that would rely on software to alter the characteristics of the radio rather than having to design new hardware each time a new radio is designed or a new feature is added. This could speed up time-to-market for deploying future air interfaces and subsequent feature enhancements. Network operators could extend the useful life of the infrastructure equipment as air interfaces evolve. AirNet is also in agreement with Motorola regarding the SDR benefit to the operators. "SDR technology will prove to be an effective tool in encouraging greater interoperability among public safety systems."

In its comments, Ericsson states that SDR is an interesting new implementation technology with the potential to bring benefits to consumers as well as the communications industry and further states that SDR is neither ready for commercial implementation nor is it a panacea for eliminating spectrum shortages. AirNet agrees that SDR is not a panacea for eliminating spectrum shortages, however, AirNet points to the fact that SDRs have already been successfully deployed commercially. AirNet believes

that SDR is more than just downloading software to base stations and terminals, as claimed by some respondents.

Ericsson states that dual-mode or multi-mode devices can be built with or without SDR implementation technology. Ericsson is correct, but there is a cost to the consumer. Non-SDR base stations cannot be software downloaded to provide dynamic control of frequency, modulation, power, and protocol. Again SDR as defined by the SDR Forum is consistent and should be used as the reference.

2. Interoperability

AirNet firmly believes that SDR technology can provide interoperability between different frequency bands and between different RF standards.

Due to the advent of wireless Internet, we are witnessing a convergence between the Internet and the wireless spheres. As a result, the old non-SDR technology paradigm that governed wireless voice is increasingly obsolete when it comes to wireless Internet. We are seeing tremendous advances in wireless Internet standards in the U.S. and around the world. To be able to support such changes, a software-based platform is the only logical choice for the U.S. wireless industry.

AirNet believes that an additional driving force for SDR will be the interoperability from the evolution of analog technology to 2G to 2G+ (GPRS/EDGE) and then to 3G technology. In order to support legacy cellular analog terminals, the infrastructure of existing networks will still be required as the population of terminals continue to decrease. SDR equipment could be deployed permitting the removal of the analog base stations while upgrading the network for supporting advanced 2G and 3G services while still serving the analog terminals.

AirNet agrees with the comments of SBC in regards to multi-mode DSP functionality where SBC states that "a given DSP can change the function it is performing at any time by downloading new software from the memory store. Thus, for example, the DSP can process an AMPS call in one moment, an ANSI-136 the next, and an EDGE call thereafter. Different DSPs may also be processing different protocols simultaneously (e.g. ANSI-136 and EDGE). For example, an operator would no longer be required to put either analog or digital radios in the base station, with a resulting static assignment of resources, rather this could be full-dynamic on a call by call basis if desired."

As the NTIA appropriately stated in their comments interoperability between public safety agencies has been a major problem. Interoperability can be provided with today's technology. Various comments stated that commercial off-the-shelf digital signaling processors were not available with the processing capability to control frequency, modulation, power output and protocol conversion. The AirNet architecture utilizes commercial off-the-shelf digital signaling processors.

AirNet agrees with the SDR Forum comments on interoperability: “By programming each channel to a different air interface, and programming the networking side of the SDR to perform bridging and gateway functions, public-safety agencies will be able to rely on SDR to provide connectivity between multiple air interfaces, quickly and conveniently.”

3. Improved Spectrum Efficiency and Spectrum Sharing

SDR technology enables the smooth migration from voice/data services of 2nd generation technologies to multi-media services of 3rd generation technology. It will result in tremendous improvements in spectrum efficiency, lowering the costs of providing wireless service for the U.S. business and consumers. SDR also lays the foundation for further advances in RF technologies such as adaptive antenna technology and dynamic channel allocation (to minimize interference), which could further improve the spectrum utilization for operators.

Ericsson states that the benefits of the functionality to allow customers to be migrated between spectrum resources can only be gained when base stations and terminals achieve widespread adoption and when standards are in place defining the required capabilities of such systems to adapt to new spectrum resources. AirNet believes that spectrum efficiency issues are generally defined today by the existing standards limitations, in the future with the advent of more RF control at the antenna and more efficient modulation techniques, spectrum efficiency can be improved. Does this mean that the wireless industry should wait for improved RF technology prior to moving forward with the implementation and deployment? AirNet contends that the dependencies and standards issues as cited by Ericsson are not valid and that the U.S. industry should move forward.

AirNet believes that spectrum efficiency through improved modulation techniques and through spectrum sharing (searching for idle or unused quiet channels) is realistic. APCO states in their comments that “a great danger is, an SDR could unintentionally disrupt a critical and ongoing, but briefly ‘quiet (channel)’ public safety emergency communication.” AirNet believes that although the FCC is searching for ways to improve spectrum efficiency there is no intention of the FCC to “scan” the entire spectrum in search of idle channels. However, the concept of spectrum sharing should at least for the near term, be limited to well-defined frequency bands of similar technologies. For example, in the near term the frequency bands 800 MHz and 1.9 GHz could be used for 2-way PCS or cellular wireless services to improve and cross utilize idle spectrum. Another example would be to use the existing frequency bands (30-50 MHz, 162-174 MHz, 406-420 MHz, 450-512 MHz, 764-776 MHz, 794-806 MHz, and 806-940 MHz) of the public safety services and provide interoperability between selected bands as well as search for idle channels.

When technological advances create the ability to control frequency and modulation at or near the antenna, SDR will have the ability to scan much wider bandwidths for “quiet”

channels. In the interim, we should limit dynamic channel allocation to predefined spectrum bands, and agree that specific spectrum etiquette rules must be established for each service requirement.

4. Equipment Approval and Regulation Changes

In regards to the FCC approval of hardware or software, the SDR Forum suggests that if software changes are made that could affect the RF parameters then FCC re-certification would be required. One of the advantages of the SDR is the ability to adapt quickly and easily to market demands for new features and capabilities. Likewise, the FCC rules regarding approval of SDR should support this ability. AirNet is in agreement with Nortel for a simple approval process for SDR equipment. The software of SDR should not require an additional approval by the FCC unless the intended use is beyond the scope of the original approval.

AirNet believes that changes to radio software can be effectively self-regulated and FCC approval is not required unless software changes are made that impair the performance as required by the FCC. Rules should be adopted to ensure that the manufacturer performs and maintains records of testing for out-of-band emissions that are subject of FCC review with each software change affecting RF performance.

SBC proposes that “if a common hardware platform is used to implement multiple standards then it is not just the hardware or just the software that needs to be certified, but the combination. Any software change, or addition, that would have an impact on the RF performance of the equipment should require a new certification.” AirNet suggests that re-certification is required only when software or hardware changes are made that degrade the RF interference beyond the limits established by the FCC.

APCO states in their comments that SDRs are still in the very early stages of development and experimentation and that an over-reliance of software to control frequency for public safety could impose unacceptable risks and failure. AirNet’s base station equipment has been deployed since 1997 and the software development includes the necessary controls and safeguards to prevent such occurrences.

Although APCO did not specifically state their concerns of a “Wireless Lovebug” as related to software tampering, AirNet would like to discuss in the same context that concern. In the Harris comments regarding tampering and hacking, Harris discussed their concerns of a standardized protocol and interface for downloading software. Harris stated that the “definition of a common SDR architecture could increase its susceptibility to infrastructure exploitation, such as a Wireless Lovebug”. A standards-based architecture that identifies general functionality and open interface standards provides economic benefits. The security of such an architecture must weigh the advantages and disadvantages of a common platform. AirNet believes that additional work remains on the issue of security and authentication, however, AirNet supports Harris in their

concerns of a standardized interface and believes that FCC regulation of Security or Authentication could stifle the development and eventual deployment of SDR.

AirNet agrees with the SDR Forum in regards to the effect that SDRs would have on the uniformity of standards. "There is nothing inherent in SDR implementation techniques that forces or even encourages uniformity of standards." In fact, SDR could proliferate an additional number of standards due to the ease of interoperability.

AirNet also supports Lucent Technologies regarding the flexibility of the Commission's regulation to allow for the further development of SDR. Imposing unnecessary rules early would stifle the innovation and the development of SDR to serve public interest. AirNet supports Lucent in their comments that state "flexibility in conformity assessment schemes are essential and consistent with conformity assessment trends worldwide. Requiring authentication codes for first party (hardware manufacturer) software deployment or certification approval for *all* software changes would unnecessarily prolong the time needed to bring a product to market and would mandate substantially increased cost for consumers, service providers, and manufacturers. Lucent technologies believes that an FCC decision to impose such requirements would be damaging and are clearly unwarranted." It is clear that security and authentication procedures will require careful scrutiny. AirNet believes that the methods discussed in the NTIA comments should be carefully considered but standardization of common platforms and architectures could be an Achilles heel.

Respectfully Submitted,

Timothy J. Mahar
VP Marketing and Strategic Business Development